DOES FUNCTIONAL COMMUNICATION TRAINING COMPETE WITH ONGOING CONTINGENCIES OF REINFORCEMENT? AN ANALYSIS DURING RESPONSE ACQUISITION AND MAINTENANCE

By

MELISSA J. SHIRLEY

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MELISSA J. SHIRLEY

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Chair: Henry S. Pennypacker
Cochair: Brian A. Iwata
Major Department: Psychology

Research on functional communication training, or FCT, typically has included extinction, time out, or punishment as a treatment component, and the extent to which these procedures determine the effectiveness of FCT is unclear. In this study, both acquisition and maintenance of the target (alternative) response were examined during treatment with FCT while inappropriate behavior was concurrently reinforced. Following the completion of functional analyses in which it was determined that SIB was maintained by either escape from task demands (one individual) or access to specific materials (two individuals), FCT was implemented in a multiple baseline across subjects design. During FCT, an alternative response consisting of a manual sign was taught to each individual, using the reinforcer that maintained SIB. When FCT was implemented without extinction of SIB, SIB remained at baseline rates for all subjects, and none of the subjects acquired the alternative manual sign. When extinction was added to the procedure, SIB decreased and the manual sign increased for all subjects. To determine if signing, once established, would compete

with SIB when both were reinforced, extinction was then withdrawn. Signing maintained while SIB occurred at low rates for two individuals, but SIB returned to baseline rates for the third individual, necessitating the reimplementation of extinction. These results suggest that it may be difficult to establish alternative behaviors if inappropriate behavior continues to be reinforced, but that, once established, alternative behavior might compete successfully with ongoing contingencies of reinforcement for inappropriate behavior.

CHAPTER 1
INTRODUCTION

Self-Injurious Behavior

The purpose of the present study is to evaluate the effectiveness of functional communication training, alone and with extinction, as a treatment for self-injurious behavior (SIB). SIB is defined as any act that produces injury to an individual's own body (Tate & Baroff, 1966). Examples include head hitting and banging, hand and arm biting, scratching, hand mouthing, eye poking, pica, rumination, rectal digging, and aerophagia (swallowing air). de Lissovoy (1961) conducted a study to determine the prevalence of head banging among normal infants. Although this study reported a higher prevalence among male children (22.3%), females also exhibited the behavior to some degree (7.4%). Although SIB is seen in normal children, it is more prevalent among individuals with developmental disabilities. One study reported that 13.6% of individuals living in institutions for persons with developmental disabilities exhibit some form of SIB (Griffin, Williams, Stark, Altmeyer, & Mason, 1984). Another study reported that 10% of the residents of a state institution for persons with mental retardation exhibited some form of self-injury (Schroeder, Schroeder, Smith, & Dalldorf, 1978). SIB was more frequent among those with severe and profound mental retardation than among those with mild or moderate mental retardation.

Although some cases of SIB may be associated with medical conditions such as Lesch-Nyhan syndrome (Lesch & Nyhan, 1964), most SIB is the result of environmental variables (Carr, 1977). The treatment of SIB has focused primarily on behavioral interventions, which often have been applied irrespective of the variables maintaining the behavior (Repp, Singh, Olinger, & Olson, 1990). That is, reinforcement and punishment

procedures have been implemented without attempting to identify the function(s) of the self-injury. Repp et al. (1990) conducted a review of the literature on the treatment of SIB, the results of which indicated that "very little applied research addresses the theoretical explanations of why SIB occurs" (p. 101). In addition, they reported that the choice of treatments used in the published studies was made independent of an analysis of the maintaining variables.

Functions of Self-Injurious Behavior

It has been suggested that many treatment failures are the result of lack of knowledge regarding the function of the target behavior, and Carr (1977) discussed several hypotheses related to the functions of SIB. The positive reinforcement hypothesis states that SIB "is a learned operant, maintained by positive social reinforcement, which is delivered contingent upon performance of the behavior" (p. 801). According to this theory, SIB should increase when positive reinforcement is made contingent upon the behavior, decrease when positive reinforcers are removed following the behavior, occur at high rates in the presence of others, and occur at low rates when alone. The positive social reinforcement that functions to maintain SIB may take the form of attention (Lovaas, Freitag, Gold, & Kassorla, 1965) or access to preferred items (Lovaas & Simmons, 1969). In a recent epidemiological study, Iwata, Pace, Dorsey et al. (1994) found that 26.3% of self-injurious behavior was maintained by positive reinforcement.

Another hypothesized function of SIB described by Carr (1977) is negative reinforcement. This hypothesis states that SIB "is maintained by the termination or avoidance of an aversive stimulus following the occurrence of a self-injurious act" (p. 805). Most commonly, negatively reinforced SIB has been shown to be maintained by escape from demands; however, escape from social interaction, physical examinations, and noise have also been shown to maintain SIB. Iwata, Pace, Dorsey, et al. (1994) found

38.1% of SIB to be maintained by negative reinforcement.

A third hypothesis proposed by Carr (1977), the sensory stimulation hypothesis, is that SIB is maintained in the absence of social reinforcers by the tactile, kinesthetic, and vestibular stimulation produced by the behavior. According to this hypothesis, a lack of stimulation in the environment sets the occasion for SIB. Thus, SIB is likely to be seen when an individual is alone or without stimulating leisure items available. The proportion of SIB maintained in the absence of social consequences is estimated to be 25.7% (Iwata, Pace, Dorsey, et al., 1994).

SIB has also been hypothesized to be a result of physiological abnormalities (Carr, 1977). The organic hypothesis is relevant to such conditions as the Lesch-Nyhan syndrome, in which an enzyme deficiency may produce self-biting (Lesch & Nyhan, 1964). This hypothesis suggests purely physiological causes of behavior that may not be susceptible to environmental manipulation.

Finally, psychodynamic hypotheses state that self-injurious behavior occurs in order to alleviate guilt, establish bodily reality, or trace ego boundaries (Carr, 1977). For example, Zuk (1960/1985) states that self-injury represents:

> a regression of the ego to an infantile level with a consequent breakdown of the identification of the ego and the body. The body is no longer perceived as an extension of the self but as an *object* in the environment. When for some reason, perhaps fear of reprisal or lack of availability aggression cannot be directed against its true object, it is conceivable that it is expended against the most immediate or the nearest object. Since the victim obviously has easy access to his own body, it tends frequently to get selected as the object of the aggression. (Zuk, 1960/1985, p. 104)

Psychodynamic theories such as these, however, have not been subjected to sufficient empirical tests to establish their adequacy.

Functional Assessment and Functional Analysis Methodologies

Just as there are many hypothesized functions of self-injurious behavior, there are several methods for identifying the reinforcers that maintain a given individual's SIB. Functional assessment methodologies are those in which the variables hypothesized to

control the frequency of self-injury are not directly manipulated. Functional assessment methodologies include indirect assessments and descriptive analyses. Functional analyses, by contrast, involve the direct, experimental manipulation of such variables.

Indirect Assessments

Indirect assessments obtain information relevant to the function of SIB through interview or questionnaire methods. Family members or persons working with the individual are asked questions regarding the circumstances that surround the occurrences of SIB. One frequently used method of indirect assessment is the Motivation Assessment Scale (MAS) (Durand & Crimmins, 1988). The MAS consists of a series of 16 questions regarding the circumstances in which the behavior occurs (e.g., "Does this behavior occur following a command to perform a difficult task?" p. 102). Informants are asked to select an answer from a 7-point Likert scale ranging from "always" to "never." The MAS allows the administrator to categorize an individual's SIB as maintained by either negative reinforcement (escape), sensory stimulation, positive reinforcement in the form of attention, positive reinforcement in the form of access to preferred items, or a combination of these. Other assessment instruments that are similar to the MAS are the Motivation Analysis Rating Scale (MARS) (Wieseler, Hanson, Chamberlain, & Thompson, 1985), Functional Analysis Interview Form (FAIF) (O'Neill, 1990), and the Stimulus Control Checklist (Van Houten & Rolider, 1991).

The advantages of indirect assessments are that they are quick, easy, and do not require conditions that may set the occasion for high rates of self-injury. They may, however, not be reliable methods for assessing function (Sturmey, 1994; Zarcone, Rodgers, Iwata, Rourke, & Dorsey, 1991). For example, Zarcone et al. (1991) administered the MAS to persons working closely with 39 individuals in an institutional setting and 16 individuals in a school setting. Two raters completed the instrument for each individual. Inter-rater reliability was assessed using both correlational analyses and percentage agreement. The

results of this study found a mean Pearson correlation of only 0.41 and a mean interobserver agreement of less than 20%, suggesting a lack of reliability using the Motivational Assessment Scale.

Descriptive Analyses

Unlike indirect assessments, descriptive analyses involve direct observation of the individual in his/her natural environment. These methods represent an improvement over indirect assessments in that actual data are collected on the behavior of interest. No environmental manipulations are made in descriptive analyses, however. Bijou, Peterson, and Ault (1968) suggested a method whereby an observer records, in narrative form, the subject's behavior, as well as related antecedent and consequent events. Information obtained in these initial observations is used to construct an observational code for further observations. Observational codes for behaviors (e.g., S = SIB), antecedent (e.g., D = demand) and consequent (e.g., A = attention) events allow for simple and expedient data collection. Data are then analyzed and graphed to identify any relevant response patterns.

Another popular method of conducting descriptive analyses is the scatter plot, described by Touchette, MacDonald, and Langer (1985). Touchette's scatter plot is a method of data collection in which data are recorded on a grid that is divided into 30-minute intervals across the day. Observers record the frequency of the target behavior as zero, low frequency, or high frequency for each interval. The scatter plot is expected to reveal patterns of behavior associated with "time of day, the presence or absence of certain people, a social setting, a class of activities, a contingency of reinforcement, a physical environment, and combinations of these and other variables" (p.345). Although these procedures represent a vast improvement over indirect methods, they still reveal only correlational relationships between behavior and environment.

Functional Analyses

Experimental, or functional, analyses are a third type of behavioral assessment. These

methods involve the actual manipulation of the antecedents that set the occasion for, and the consequences that maintain, self-injurious behavior. The functional analysis methodology was developed by Iwata, Dorsey, Slifer, Bauman, and Richman (1982) and involves the comparison of rates of self-injury in three experimental and one control condition. The social disapproval condition is designed to test for self-injury maintained by positive reinforcement in the form of attention. The academic demand condition attempts to identify self-injury maintained by escape from instructions. The alone condition is designed to identify self-injury maintained in the absence of social consequences. The control condition, unstructured play, consists of attention, toys, and the absence of demands, and is not expected to evoke SIB. Comparing the rates of self-injury across the four conditions enables the experimenter to identify the potential function or functions of the individual's self-injurious behavior.

Since the introduction of the functional analysis in 1982, several variations have emerged. Because they found functional analyses "complex, time consuming, and cumbersome" (p. 10) as well as impractical in a short-term out patient setting, Northup et al. (1991) developed a brief functional analysis. Although similar to the method described by Iwata et al. (1982) (i.e., similar test and control conditions), the brief functional analysis differs in that each session lasts only 5-10 minutes with a 1-2 minute break between sessions. The entire functional analysis takes 90 minutes or less. In addition to shortening the duration of the functional analysis, they also added an assessment of alternative replacement behaviors. After identifying the condition of the functional analysis that produced the highest rates of SIB, a contingency reversal was conducted. In the contingency reversal, the consequences previously provided for inappropriate behavior were now placed on an appropriate response. This allowed the experimenters to determine if a replacement behavior would be maintained in the same circumstances that were shown

to maintain the problem behavior in the functional analysis.

Another type of experimental analysis has been described by Durand (1982). In this type of analysis, the focus is on the manipulation of antecedent events rather than consequences. For example, to test for negatively reinforced SIB, conditions in which easy demands are presented are compared with conditions in which difficult demands are presented. Higher rates of SIB in the difficult demand condition are said to indicate escape maintained SIB. Carr and Durand (1985a) describe a functional analysis in which the rates of SIB in three conditions (Easy 100, Easy 33, and Difficult 100) were compared. The Easy 100 condition is the control condition. During this condition, easy demands were presented throughout the session and attention was presented in 100% of the 10-second intervals. Easy demands were also presented in the Easy 33 condition. In this condition, however, attention was provided in only 33% of the 10-second intervals. This condition is said to test for attention maintained self-injury. Finally, the Difficult 100 condition tests for SIB maintained by escape from demands. In this condition, attention was provided in 100% of the 10-second intervals; however, difficult tasks were presented throughout the session. Although not operationally defined in this study, the distinction between difficult and easy demands has been described elsewhere (Durand & Carr, 1991): Difficult tasks are those on which the individual responded correctly about 25% of the time; easy tasks are those on which the individual responded correctly 100% of the time.

Although Carr and Durand's (1985a) antecedent analysis is designed to test for SIB maintained by positive and negative reinforcement, as does the Iwata et al. (1982) functional analysis, it does not involve the manipulation of consequences. The Difficult 100 condition does not actually provide escape contingent upon self-injury. Similarly, contingent attention is not provided in the Easy 33 condition. Thus, it is unclear whether escape and attention, respectively, actually function as reinforcers.

In conclusion, there are a number of methods for identifying the function of an

individual's self-injurious behavior, each with its own advantages and disadvantages. Selection of an appropriate and effective means of gaining information related to function is an essential step in the treatment process. Inaccurate identification of the function of SIB can lead a therapist to waste time and energy on ineffective treatments. In addition, treatments based on incorrectly assumed functions of SIB can be dangerous by exposing individuals to treatment that is ineffective at best, and that might exacerbate SIB at worst. By precisely identifying the function of SIB, effective treatments can be designed by altering the specific contingencies maintaining the behavior.

Function-Based Approaches to the Treatment of SIB

Although early research often reported the failure of behavior analytic interventions in treating self-injurious behavior, treatments designed following an adequate functional analysis have met with much greater success. The identification of reinforcers maintaining SIB through the use of a functional analysis allows for the development and implementation of interventions that focus on decreasing or eliminating SIB by reducing its effectiveness in producing the maintaining reinforcer. Alternatively, the use of the functional analysis allows for the identification of reinforcers that can be used to increase or maintain appropriate behaviors. Thus, the use of functional analysis methodologies allows for the development of two general categories of intervention, including: (a) treatments that are designed to remove the contingency between SIB and its maintaining reinforcer, and (b) treatments that are designed to reduce the motivation to exhibit SIB by providing the maintaining reinforcer either contingent upon other behaviors or noncontingently. Many procedures that have proven to be effective in the treatment of SIB are, in fact, combinations of the two types of procedures. As will be further discussed, the effectiveness of these treatments may depend, to a great extent, upon the accurate of identification of the function of the problem behavior.

Extinction

The first class of treatments can be classified as extinction procedures. Extinction is defined as the termination of the reinforcement contingency that maintains a response, resulting in a reduction in the rate of the behavior over time (Cooper, Heron, & Heward, 1987). The incorrect application of extinction procedures exemplifies the need for a comprehensive functional analysis prior to the development of an intervention plan. Iwata, Pace, Cowdery, and Miltenberger (1994), for example, demonstrated the necessity of identifying the function of self-injurious behavior prior to attempting an extinction procedure. They defined three types of extinction, labelled EXT (attention), EXT (escape), and EXT (sensory). EXT (attention) is an appropriate treatment for the reduction of SIB maintained by positive reinforcement in the form of attention. Procedurally, EXT (attention) consists of terminating the contingency between SIB and the provision of attention. In other words, attention is no longer provided following self-injury. EXT (escape) is an appropriate treatment for the reduction of SIB maintained by negative reinforcement in the form of escape from demands. Procedurally, EXT (escape) consists of disallowing escape from demands following SIB. That is, following SIB the individual is required to complete the task assigned. Finally, EXT (sensory) is designed as a treatment for SIB maintained by sensory stimulation. Procedurally, EXT (sensory) consists of attenuating the sensory consequences for SIB, generally through the use of protective equipment. In the current study, a helmet was used to extinguish head banging.

The study by Iwata, Pace, Cowdery, et al. (1994) involved the application of the different types of extinction procedures to three subjects following a functional analysis. The first subject exhibited SIB across all four functional analysis conditions, indicating SIB maintained in the absence of social reinforcers. Whereas sensory extinction [EXT (sensory)] was effective with this subject, neither EXT (attention) nor EXT (escape) reduced SIB significantly. The second subject exhibited SIB almost exclusively in the demand condition, suggesting escape maintained behavior. In the case of this subject,

sensory extinction was ineffective. Escape extinction [EXT (escape)], however, was effective in reducing self-injury to near-zero levels. The final subject exhibited SIB predominately in the attention condition, indicating positively reinforced SIB. Again, sensory extinction was ineffective, whereas attention extinction [EXT (attention)] in combination with differential reinforcement of other behavior reduced SIB to near-zero levels.

In summary, this study demonstrated the ineffectiveness of using a non-function based approach to treatment. That is, selecting extinction as a treatment procedure without regard to the variables maintaining SIB may not result in a decrease in the target behavior if the function and the treatment are not matched.

Noncontingent Reinforcement

The second class of treatments consists of a variety of reinforcement procedures that are likely to reduce inappropriate behaviors because (a) they provide an alternative means of obtaining the reinforcer and (b) they are generally combined with extinction procedures. The first of these procedures to be discussed are non-contingent reinforcement (NCR) procedures. In an NCR procedure, reinforcers are delivered irrespective of the presence or absence of self-injurious behavior, generally according to a time-based schedule. In addition to decreasing the motivation to engage in SIB by providing access to reinforcers, NCR is usually combined with extinction. That is, reinforcers are only provided non-contingently; SIB does not result in additional reinforcers. For example, Vollmer, Iwata, Zarcone, Smith, and Mazaleski (1993) compared noncontingent reinforcement to another reinforcement procedure in treating the attention maintained self-injurious behavior of three profoundly retarded women. Noncontingent attention was delivered on a fixed-time schedule irrespective of SIB. SIB was placed on extinction; that is, it was ignored. Results indicated that NCR, in combination with extinction, was effective in reducing the

rates of SIB for all three subjects.

Procedurally, NCR does not require the delivery of the reinforcers that maintain self-injury. NCR, in other words, can be conducted using arbitrary reinforcers. This, however, may not be as effective as the use of the procedure with the functional reinforcers. For example, Corte, Wolfe, and Locke (1971) attempted to treat the self-injurious behavior of a profoundly retarded adolescent without knowledge of the function of his SIB. A noncontingent reinforcement procedure was used in which food was delivered to the adolescent on a fixed time 15-second schedule regardless of the subject's behavior. Unlike the use of NCR in Vollmer et al. (1993), in which subjects were provided the functional reinforcer, NCR using an arbitrary reinforcer was ineffective in reducing SIB. This, again, emphasizes the need for a function-based approach to the treatment of SIB.

Differential Reinforcement

Another member of this second class of treatment procedures consists of those procedures termed differential reinforcement procedures. Differential reinforcement procedures are the most common method of treating behavior problems among individuals with mental retardation (Lennox, Miltenberger, Spengler, & Erfanian, 1988). The two most commonly used types of differential reinforcement procedures are DRO (differential reinforcement of other behavior) and DRA (differential reinforcement of alternative behavior). Unlike noncontingent reinforcement, differential reinforcement procedures are contingent upon responding. In the case of DRO procedures, reinforcement is made contingent upon the absence of responding for a specified interval of time. Although DRO procedures can be used in isolation, they are probably most effective when used in combination with extinction. That is, reinforcement should only be provided for the absence of SIB.

Like NCR procedures, the reinforcer delivered may or may not be the reinforcer that

maintains SIB. Whereas LaVigna and Donnellan (1986) state that under ideal conditions the reinforcer should be that which maintains SIB, they consider it an advantage of the procedure that this need not be so. It appears from the literature, however, that DRO procedures that use reinforcers other than those maintaining SIB may not be effective. Harris and Wolchick (1979), for example, used attention as a reinforcer in a DRO procedure for two subjects whose self-stimulatory behavior was maintained by unknown variables. This procedure actually resulted in an increase in the number of self-stimulatory responses (M = 13.8 responses per session) over baseline (M = 10.8 responses per session) for one subject. The second subject showed only a slight decrease in self-stimulatory behavior from a mean of 12.4 responses per session in baseline to a mean of 10.84 responses per session during the DRO procedure. This procedure was then repeated with two additional subjects. For these subjects, however, the DRO procedure included the provision of attention and food for the absence of self-stimulatory behaviors. Again, one subject showed a slight decrease in self-stimulatory behaviors from a mean of 27.4 response per session in baseline to a mean of 20.15 responses per session during DRO. The other subject, however, showed no improvement at all (BL: M = 14.7 responses per session; DRO: M = 15.5 responses per session). Thus, it appears that using a DRO procedure consisting of stimuli that have not previously been demonstrated to be reinforcing is not an effective method of treating problem behaviors.

Whereas DRO procedures provide reinforcement for the absence of responding, DRA procedures provide reinforcement contingent upon a response other than SIB. This response may be either arbitrary or incompatible with SIB. As in NCR and DRO procedures, DRA procedures may be used in conjunction with extinction. That is, reinforcement may be provided only for the alternative response and withheld following SIB.

One study showing the successful use of DRA plus extinction in the treatment of self-

injurious behavior was conducted by Day, Rea, Schussler, Larsen, and Johnson (1988). In this study, a functional analysis was conducted to determine whether the SIB of three individuals was maintained by positive, negative, or sensory reinforcement. Treatment was then designed using the type of reinforcement found to maintain the self-injury. Two subjects were found to have SIB maintained by positive reinforcement in the form of access to preferred items. These subjects were taught to make an alternative response that produced access to the preferred item. In addition, the preferred item was no longer provided following self-injurious responses. The third subject's self-injury did not appear to be maintained by social consequences. Hence, she was taught to wave her hand in order to gain access to a radio. Again, the radio was not provided following self-injurious responses. These DRA procedures were found to be effective in reducing the self-injurious behavior of all three subjects.

DRA procedures that do not begin by assessing the function of the problem behavior, however, may not be as effective. Young and Wincze (1974) conducted a study designed to compare the use of DRA (differential reinforcement of alternative behavior) and DRI (differential reinforcement of incompatible behavior) on the self-injurious behavior of a 21 year old woman with profound mental retardation. Because no functional analysis was conducted to identify the reinforcers maintaining the subject's self-injury, arbitrary reinforcers were used in both procedures. The DRA procedure consisted of providing the subject with a spoonful of ice cream and social praise contingent upon one second of eye contact. The DRI procedure consisted of providing the subject with a spoonful of ice cream and verbal praise contingent upon having her hands on the wheels of her chair for at least one second. This response was incompatible with one of the subject's topographies of SIB, head hitting; however, it was not incompatible with head-to-rail (of bed or chair) banging. Results indicated that the DRA procedure was ineffective in reducing the subject's rate of SIB. The DRI procedure did result in a reduction in head hitting;

however, head-to-rail banging increased concurrently with the decrease in head hitting. It is likely that the use of a reinforcer other than that which maintained the subject's SIB contributed to the failure of these differential reinforcement procedures as treatments for problem behavior, again providing support for the movement toward function-based approaches to the treatment of self-injurious behavior.

Functional Communication Training

FCT and The Communication Hypothesis

A special class of DRA procedures, called functional communication training or functional equivalence training, exemplifies the use of a function-based approach to treating self-injurious and other problem behaviors. This procedure has resulted from the notion "that SIB may be conceptualized as similar to communication in that it may also serve to control the behavior of other people" (Day, Johnson, & Schussler, 1986, p. 123; see also, Durand, 1986). A review of the history of the communication hypothesis can be found elsewhere (Carr & Durand, 1985b). Based on notions such as this, self-injurious behavior should not be categorized as "maladaptive," but rather as "adaptive and functional" (Carr & Durand, 1985b, p. 249). This view has led to the development and introduction of the procedure known as functional communication training. Others have argued, however, that all inappropriate behaviors may not be correctly classified as communicative (Cipiani, 1990). Cipiani (1990) argues that only behavior that "is shaped and maintained through the mediation of someone else . . . is communicative in nature" (p. 244). Behavior that is maintained by the direct effect it achieves on the environment, however, is not communicative. Although Carr and Durand do not claim that all inappropriate behaviors are communicative, they believe that noncommunicative behaviors can be effectively treated with communication-based interventions.

Functional communication training (FCT) is a procedure first introduced by Carr and

Durand (1985a) for the treatment of aggressive, disruptive, and self-injurious behaviors. FCT is composed of a two-step sequence in which (a) an assessment is conducted to identify the reinforcers that maintain problem behavior, and then (b) intervention is implemented using those reinforcers to strengthen a more socially acceptable response in the context in which the problem behavior typically occurs. The rationale behind this approach is that an individual will be less likely to engage in the problem behavior if (s)he can gain access to reinforcement by exhibiting the alternative response.

Functional Equivalence

Although FCT is similar to other differential reinforcement procedures, it requires that the alternative response be functionally equivalent to the target (inappropriate) response. That is, the alternative response must be followed by the reinforcer that maintains the target response. Differential reinforcement of alternative behavior (DRA) and differential reinforcement of other behavior (DRO) procedures may or may not use the maintaining reinforcer as the consequence for the alternative response or the absence of the target response.

A study by Carr and Durand (1985a) demonstrated that using an arbitrary reinforcer may not be as effective as providing the reinforcer that maintains the behavior targeted for reduction. They conducted an antecedent analysis of the challenging behaviors of four children with developmental disabilities. After identifying the "function" of the target behaviors, the children were taught a "relevant" verbal response that would produce the maintaining reinforcer and an "irrelevant" verbal responses that would produce irrelevant attention. For example, a subject whose disruptive behavior occurred at high rates during a difficult demand condition was taught to say "I don't understand" (relevant) and, later, "Am I doing good work?" (irrelevant). Alternatively, a subject whose rates of disruptive behavior were highest in a low attention condition was taught to say "Am I doing good work?" (relevant) and, later, "I don't understand" (irrelevant). In either case, the verbal

response "I don't understand" resulted in assistance, whereas "Am I doing good work?" was followed by praise. The results indicated that teaching a relevant response decreased the disruptive behaviors, whereas teaching an irrelevant response did not reduce the inappropriate behaviors. Thus, by matching the function of the appropriate and inappropriate behaviors, disruptive behaviors were reduced.

Likewise, Duker, Jol, and Palmen (1991) taught 14 individuals with SIB and/or aggression to emit communicative gestures that were reinforced by ward staff. However, no functional analyses or assessments were conducted to identify the reinforcers maintaining the inappropriate behaviors. Instead, staff were asked to identify signs or gestures that might be helpful to the individual in his/her living environment. Although the rates of inappropriate behavior between baseline and intervention were shown to be statistically significant, the decrease was reportedly not clinically significant. The authors indicated that greater effects may have been found if treatment and selection of gestures had been based on an identified function of problem behavior.

FCT has been used to treat a variety of behavior disorders, including SIB and aggression (Carr & Durand, 1985), disruption and destruction (Campbell & Lutzker, 1993) and stereotypy (Durand & Carr, 1987). For example, Durand and Carr (1987) treated the stereotypic behaviors (hand flapping and body rocking) of four children. Antecedent analyses revealed that the subjects' stereotypy was escape maintained behavior. Subjects were taught to say "Help me" in order to get teacher assistance. Stereotypic behaviors were ignored. All subjects began using the communicative phrase, and stereotypic behavior decreased to near-zero levels.

Generalization and Maintenance

The proposed benefits of FCT include the endurance of treatment effects and their ability to generalize to other contexts. Durand and Carr (1991), for example, demonstrated that 2 of 3 boys with developmental disabilities continued using their communicative

responses and emitting low rates of challenging behavior two years after FCT was implemented. Durand and Carr (1992) also found that the effects of FCT transferred to untrained contexts, whereas the effects of a time-out procedure did not. Two groups of children with developmental disabilities and challenging behaviors were subjects. One group received FCT, in which they were taught appropriate verbal phrases to gain attention. The other group received time out from positive reinforcement for emitting inappropriate behaviors. Both treatments were effective in reducing challenging behavior. Later, the children were introduced to naive trainers who were given no information on how to respond to challenging behaviors. Whereas those in the FCT group maintained low rates of inappropriate behavior, the time out group returned to baseline levels. The individuals in the FCT group continued to emit their verbal responses, which were easily recognized and reinforced by the naive trainers. Thus, FCT has been shown to generalize to naive trainers and to maintain over long periods of time.

Other studies, however, have shown that communication training may not generalize to nontraining settings. Horner and Budd (1985) taught an 11-yr-old boy with autism five signs including, "juice," "timer," "choose," "bottle," and "folder." Training sessions were conducted in an isolated corner of the classroom under conditions that simulated problem situations. Under these conditions, although all signs were learned in the simulation setting, inappropriate behavior did not decrease and each sign occurred only once in the natural setting. Training in the natural setting resulted in the acquisition of all five signs and a reduction in problem behaviors in that setting. Perhaps, then, in some cases it is important for training to be conducted in the relevant setting under the conditions in which the problem behavior occurs.

One study that exemplifies the training of communication responses in the natural environment was conducted by Carr and Carlson (1993). They demonstrated the effective use of FCT as part of a multicomponent treatment approach in a community setting

(supermarket). A package consisting of FCT, choice making, and embedding was implemented during supermarket shopping trips. Embedding consisted of inserting a request that was likely to result in problem behavior among several requests that were unlikely to result in such behavior. The choice making procedure allowed the subjects to select preferred items while in the supermarket. FCT was used to teach the individuals to request desired items in an appropriate manner. Using this treatment package, problem behaviors decreased and the number of tasks completed in the supermarket increased.

Response Efficiency

It has been argued that response efficiency is a key factor in determining the effectiveness of FCT as an intervention for problem behavior (Horner, Sprague, O'Brien, & Heathfield, 1990). These authors suggested that variables such as physical effort, schedule of reinforcement, and latency to reinforcement will affect the distribution of responses across appropriate and inappropriate behaviors. In other words, in order for an appropriate response to replace an inappropriate response, the appropriate response must require less physical effort, be reinforced on a richer schedule of reinforcement, and/or have a shorter latency to the delivery of reinforcement than the inappropriate response. Three individuals with severe mental retardation were the subjects in a series of studies conducted by Horner and Day (1991) to examine the accuracy of such claims. The first study examined the role of physical effort in the acquisition and maintenance of an appropriate replacement response. The subject, whose aggression was maintained by escape from difficult tasks, was taught two replacement responses. First, a sentence sign "I want to go, please" was taught using prompting and reinforcement. Whereas this replacement response did not compete with aggression (signing was at zero levels and aggression was frequent), teaching the subject to sign the word "break" was effective in competing with aggression (aggression decreased to zero and signing increased).

The second study examined the role played by the schedule of reinforcement in the effectiveness of FCT. The subject of this study exhibited self-injury maintained by the provision of assistance in completing tasks. In this study, a condition in which signing "help" was reinforced on an FR 1 schedule was compared to a condition in which it was reinforced on an FR 3 schedule of reinforcement. SIB was reinforced on an FR 1 schedule throughout both conditions. Although the leaner schedule of reinforcement (FR 3) did not compete with SIB, the richer schedule (FR 1) did. When both SIB and signing were reinforced on the same schedule (FR 1), signing effectively competed with SIB. Thus, although Horner and Day attributed the ability of signing to compete with self-injurious behavior to differences in response efficiency, both responses were reinforced on the same schedule (FR 1). Whereas a less efficient replacement response (FR 3) did not compete with a more efficient self-injurious response (FR 1), this does not explain the ability of signing to compete with self-injury when both were equally efficient.

The final experiment examined the role of delay to reinforcement in the effectiveness of functional equivalence training as a treatment for aggression. Again, the subject, whose aggression was maintained by escape from demands, was taught a replacement response. For this subject, the replacement response was handing the trainer a card. A condition in which handing the trainer this card was reinforced immediately was compared to a condition in which the response was reinforced after a 20 second delay. Aggression was reinforced immediately throughout both conditions. Again, the replacement response did not compete with aggression when the reinforcer was delayed for 20 seconds. However, when both the replacement response and aggression were reinforced without delay, the replacement response increased and aggression decreased to near-zero levels. As in the previous study, the authors claimed that response efficiency was the factor responsible for the ability of the replacement response to effectively compete with aggression. Again, however, both responses were equally efficient in terms of reinforcer delivery. Signing

effectively competed with aggression when both were reinforced immediately, but not when the reinforcement for signing was delayed by 20 seconds. Differences in reinforcer delivery cannot explain the effectiveness of functional communication training.

Horner and Day (1991) present this study as evidence that the efficiency of the replacement response is a key factor in determining the effectiveness of functional communication training as in intervention for SIB and aggression. The authors did not, however, demonstrate this. Although this study demonstrated that some efficiency factors (response effort, schedule of reinforcement, and delay to reinforcement) are relevant to the success of FCT, the claim that the replacement response must be more efficient than the problem behavior is unsupported. In no case was the replacement behavior made more efficient than the problem behavior, yet with equal efficiency it did compete effectively.

Control

Another factor said to account for the effectiveness of FCT as an intervention is the control of the environment that the treatment provides the individual (Carr & Durand, 1985). Lalli, Casey, and Kates (1995) suggest that a "potential benefit of FCT is that an individual can regulate delivery of the reinforcer to a greater degree when compared to treatments that rely solely on the passage of time (e.g., response-independent reinforcement), time plus the absence of aberrant behavior (e.g., differential reinforcement of other behavior; DRO), or a predetermined performance requirement (e.g., task completion)" (p. 261). Kahng, Iwata, DeLeon, and Worsdell (1996) found, however, that the delivery of the reinforcer found to maintain self-injury was effective in reducing SIB regardless of whether the individual had control over the delivery (in an FCT procedure) or not (in an NCR procedure). These results suggest that control over the delivery of reinforcement may not be an essential factor responsible for the effectiveness of FCT as a treatment for problem behaviors.

Lalli et al. (1995) add that allowing the individual such control over the environment

may, at times, not be possible. That is, it may not always be feasible to provide the requested reinforcer immediately following the communication response. For example, it may not be practical to allow an individual to escape on-going activities, such as self-care training. To address this issue, several researchers have increased the amount of task completion required prior to receiving breaks for communicative responses)Bird et al. 1989; Fisher et al, 1993, Lalli et al. 1995). Bird et al. (1989), for example, required one subject to complete more complex task sequences prior to being given the token that served as a communicative sign for escape. Another subject was able to sign at any time during the session; however, reinforcement was only provided after increasing amounts of work were completed. These procedures resulted in increased amounts of work being completed by the subjects, while self-injury and aggression remained low.

Similarly, Lalli et al. (1995) combined FCT with response chaining to increase the number of work steps completed. Three subjects whose SIB and/or aggression was maintained by escape from demands participated. After being successfully taught to say "no" in order to receive a break, the required task participation was increased. Initially, only one step was required before saying "no" was reinforced. Gradually the required number of completed steps was increased to 2, 4, 8, and finally 16. In the FR 16 condition, the therapist presented one demand and the subject was required to complete all 16 steps prior to requesting a break. If a break was requested prior to the completion of the required steps, the therapist praised the subject for appropriate communication and stated the contingency in effect. Using this procedure, all three subjects learned to complete all 16 steps with low rates of SIB and aggression. In addition, the communicative response maintained throughout all phases of the response chaining procedure.

Consequences for Inappropriate Behavior

Although research on FCT suggests that the procedure can have enduring treatment effects (Durand & Carr, 1991), the processes by which behavior reduction is achieved

often remain unclear. One potentially important variable not formally emphasized in most studies on FCT is the contingency in effect for inappropriate behavior during treatment. Nevertheless, an examination of these studies reveals that most applications of FCT eliminate reinforcement for inappropriate behavior through procedures such as extinction (Bird et al., 1989; Carr & Durand, 1985a; Durand & Carr, 1992), response blocking (Durand & Carr, 1991), or some other intervention. For example, in a study by Bird et al. (1989), the escape maintained problem behavior of two profoundly retarded adults was placed on extinction concurrent with functional communication training. Problem behavior no longer produced the desired reinforcer and was therefore not functionally equivalent to the replacement response. Thus, the subjects were not choosing the socially appropriate method of obtaining the reinforcer, they were merely emitting the only effective response.

Wacker et al. (1990) conducted a component analysis of FCT to determine the necessity of removing the reinforcing consequences of problem behaviors. Three profoundly retarded individuals with self-injurious, aggressive, and stereotypic behaviors were first subjected to a brief functional analysis. After identifying the reinforcers maintaining their inappropriate behaviors, the authors implemented a treatment package consisting of functional communication training and either time-out or graduated guidance for inappropriate behavior was implemented. This treatment package was successful in reducing the inappropriate behavior and increasing the appropriate responding of all subjects. A component analysis was then conducted during which the consequence for inappropriate behavior was removed from the treatment package. Results indicated that, in the absence of a consequence for inappropriate behavior, functional communication training was not effective in reducing inappropriate behavior.

Fisher et al. (1993) also examined the effectiveness of FCT alone, with extinction, and with punishment. In the FCT alone condition, reinforcement was contingent upon

emission of either the communicative response or inappropriate behavior. Extinction consisted of ignoring inappropriate behavior, and punishment consisted of overcorrection, movement suppression time out, or contingent demands. Results indicated that, without extinction or punishment, FCT was successful in reducing the self-injury of only 1 of 3 subjects. Likewise, FCT with extinction resulted in decreased self-injury for only 1 of 3 subjects. FCT with punishment was reported to be effective with all subjects. Taken in combination, the results of Wacker et al. (1990) and Fisher et al. (1993) suggest the reported effectiveness of FCT may be due, at least in part, to the contingencies placed upon the inappropriate behavior.

A related but different issue is the ease with which the alternative response can be acquired initially using FCT alone. In most research conducted to date, the alternative response has been taught in a separate condition in which a variety of consequences are delivered following inappropriate behavior and the alternative response, and acquisition data are not presented (e.g., Bird et al., 1989; Carr & Durand, 1985a, Durand & Carr, 1991, 1992; Horner & Day, 1991; Fisher et al., 1993). Descriptions of the shaping procedures contained in these studies suggest that removing the reinforcing the consequences for problem behaviors may facilitate acquisition of the alternative response. For example, Horner and Day (1991) conducted training outside of the context of the study. Although they showed no acquisition data, they reported using a combination of blocking and extinction for at least one subject during training. Likewise, in the one study in which the alternative response was shaped directly in the treatment context, FCT was combined with extinction or time out (Wacker et al., 1990). Wacker et al. (1990) found that inappropriate behavior increased (in 2 subjects) and the alternative response decreased (in 1 subject) when these procedures were later removed, but it has been suggested that more enduring treatment effects might have been obtained if inappropriate behavior had not been exposed to extinction or time out during initial training (Durand, Berotti, & Weiner,

1993).

Purpose of the Study

To date, there has been no systematic attempt to determine if FCT as a sole intervention is effective in decreasing problem behavior and increasing the alternative response. In the present study, such an analysis was conducted by examining the effectiveness of FCT in reducing SIB and in shaping an alternative response while SIB continued to be reinforced. A second purpose of the study was to determine if the alternative response, once established, would compete with SIB if SIB were reexposed to reinforcement.

CHAPTER 2
METHODS

Subjects and Setting

Three adults living in a state residential facility for persons with developmental disabilities participated in this study. All subjects were diagnosed with profound mental retardation. They were referred to a day treatment program for the assessment and treatment of their self injury.

John was a 39-yr-old male whose SIB consisted of head banging and hand/arm biting. His forehead was deformed and he had many scars as the result of his SIB. John was independent in some self-care skills, such as eating and hand washing, but he required verbal and physical prompting with certain aspects of dressing. John could respond to simple requests but exhibited no expressive language. He had no sensory impairments. Because of a lack of stability, John required assistance to walk and wore a helmet for protection. John was taking no psychotropic medication during the course of this study.

Rick was a 29-yr-old male whose SIB consisted of head hitting and banging, and body and face slapping. His self-injury was reportedly mild, causing only redness of the skin. He was ambulatory but had severe hearing loss and retinal detachments. Rick could respond to simple requests, but exhibited no expressive language. He required assistance in completing self-care tasks. Rick was taking no psychotropic medications during the study.

Sue was a 24-yr old female whose SIB consisted of face slapping, body hitting, and hand biting. She was ambulatory, incontinent, and had no sensory impairments. Sue had no expressive language, but was able to respond to simple requests. She could eat independently; however, she required assistance to dress herself and complete household

chores.

All sessions were conducted at a day-treatment center located on the grounds of the facility. Sessions lasted for 10-15 min and were conducted 2-5 times per day, usually 5 days per week.

Response Measurement and Reliability

The primary dependent variables were occurrences of SIB and the alternative response, which consisted of a manual sign. Self-injurious behaviors included: hand biting (Sue and John), defined as insertion of any part of the hand or arm past the plane of the lips, accompanied by a biting motion of the teeth; head-banging (Rick and John), defined as forceful contact of the head against an object; head/body slapping (Rick and Sue), defined as forceful contact of the hand against another body part. The alternative responses were selected following a number of informal sessions in which the signs were observed to occur independently at a low but non-zero rate (i.e., usually once or more during a 15-min session). Rick's manual sign was a hand clasp (placing the hands together with fingers interlocked and palms facing inward), Sue's sign was a hand clap (audibly striking the palms of the hands against each other), and John's sign was a hand raise (lifting the hand above shoulder level for 3 s without touching the head). Prompted signs were those produced by a subject with assistance from an experimenter; independent signs were those produce by a subject without any assistance. Compliance consisted of the completion of the requested task without physical guidance or the emission of SIB. All data were collected using a hand-held computer (Assistant Model A 102, Human Technologies), and rates of SIB and signing were calculated by dividing the number of responses by session time. Data also were collected on experimenters' implementation of assessment and treatment procedures (e.g., delivery of instructions, prompts, and consequences); all of these measures were consistently above 95% accuracy.

Interobserver agreement was assessed by having a second observer simultaneously but independently collect data during 30%, 30%, and 39% of the sessions for Rick, Sue, and John, respectively. Agreement percentages were calculated by dividing session time into consecutive 10-s intervals. For each interval, the observers' records were compared, and the smaller number of responses was divided by the larger number; these fractions were then summed and divided by the total number of intervals in the session. Mean agreement percentages across subjects (Rick, Sue, and John) were 96.8%, 97.5%, and 98.4% for SIB, 99.8%, 97.8%, and 98.9% for independent signing, and 99.3%, 98.2%, and 98.9% for prompted signing, respectively.

Experimental Design

The experiment was divided into two parts. First, assessments were conducted using functional-analysis methodology to identify the variables maintaining subjects' SIB. Subsequently, the effects of FCT with and without extinction were evaluated in combined multiple baseline and reversal designs.

Behavioral Assessment

All subjects were exposed to four assessment conditions (attention, demand, alone, and play); Rick and Sue were exposed to an additional condition involving contingent access to leisure materials. The assessments for Rick and Sue were conducted within a multielement design (Iwata et al., 1982); John's assessment was conducted within a modified design that combined features of the multilement and reversal designs (Iwata, Duncan, Lerman, & Shore, 1994). A brief description of each assessment condition is provided here.

Attention

This was a test condition for SIB maintained by positive reinforcement in the form of attention. The subject and an experimenter were in a therapy room containing a variety of leisure materials to which the subject had free access. At the beginning of each session, the experimenter told the subject "I will be right here if you need me" and then proceeded to do

paperwork. The experimenter delivered attention (e.g. "Don't do that, you'll hurt yourself") contingent upon the occurrence of SIB but ignored the subject at all other times.

Materials

This was a variation of the attention condition and served as a test for SIB maintained by positive reinforcement in the form of access to specific materials. At the beginning of a session, the experimenter removed the subject's preferred item (a favorite shirt for Rick and a game for Sue). The experimenter returned the item for 30 s contingent upon the occurrence of SIB; at the end of the 30 s, the item was again removed.

Demand

This condition was a test for SIB maintained by negative reinforcement in the form of escape from task demands. The experimenter presented instructional trials to the subject every 30 s using a three-prompt sequence consisting of a verbal instruction, a touch prompt, and, if necessary, physical guidance. Praise was delivered for compliance. If the subject engaged in SIB at any time during the trial, the experimenter removed the task materials and ignored the subject until the next scheduled trial.

Alone

This condition was a test for SIB maintained by automatic reinforcement (i.e., SIB that persisted in the absence of social consequences). The subject was placed in a therapy room with no leisure materials available. An observer was present for data collection purposes; however, no social consequences were provided for SIB.

Play

This condition served as a control. Leisure materials were available, and the experimenter provided noncontingent attention to the subject every 30 s. No instructions were presented during the session, and no social consequences were provided contingent upon SIB.

Functional Communication Training

Each individual was exposed to a series of conditions consisting of baseline, FCT without extinction, and FCT with extinction. Because SIB served different functions across subjects, and because some conditions were either added or deleted based on an individual's pattern of responding, their procedures varied somewhat. The contingencies that were in effect during each condition are listed in Table 1 and are described in more detail below.

Treatment Conditions

Baseline. For John and Sue, this condition was identical to the assessment condition that produced the highest rate of SIB (demand and materials, respectively). Rick's baseline was similar to the materials condition of his assessment but differed in that it was conducted within the context of self-care training. The experimenter removed Rick's favorite shirt and then attempted to have Rick put on a different shirt. An instance of SIB resulted in removal of the non-preferred shirt and representation of the preferred shirt for 30 s, followed by repetition of the sequence. Signing was ignored.

FCT without extinction. This condition was conducted in a manner similar to baseline, with the addition of communication training procedures. That is, occurrences of both SIB and the alternative manual sign were followed by reinforcement.

Rick was taught to clasp his hands together in order to receive his favorite shirt. At the beginning of the session, Rick's preferred shirt was removed from his body and a non-preferred shirt was placed on him. If Rick emitted SIB or a hand clasp, the preferred shirt was returned for 30 s. If Rick did not emit either response within 5 s, the experimenter physically prompted Rick to clasp his hands together, then returned the preferred shirt for 30 s. A time-delay procedure was used to encourage Rick to emit the hand clasp independently. Following 5 consecutive trials during which no SIB occurred, the 5-s delay between trial initiation (placement of the nonpreferred shirt on Rick) and prompting of the

Table 1. Consequences for Subjects' Behaviors during Baseline and Treatment Conditions.

	Condition		
	Baseline	FCT without EXT	FCT with EXT
Rick (materials context)			
a) SIB	preferred shirt	preferred shirt	non-preferred shirt
b) Sign	continue trial	preferred shirt	preferred shirt
c) No response	continue trial	prompt sign ->pref. shirt	prompt sign ->pref. shirt
Sue (materials context)			
a) SIB	toy	toy	no consequence
b) Sign	no consequence	toy	toy
c) No response	no consequence	prompt sign->toy	prompt sign->toy
John (demand context)			
a) SIB	escape	escape	physical guidance
b) Sign	continue trial	escape	escape
c) Compliance	praise	praise	praise
d) No response	continue trial	prompt sign->escape	prompt sign->escape

hand clasp was increased by 1 s. The maximum delay for Rick was 30 s. If no signing or SIB occurred within 30 seconds of the presentation of the non-preferred shirt, the therapist prompted the sign and returned the preferred shirt for 30 seconds. No consequences were provided if Rick emitted SIB or a hand clasp while wearing the preferred shirt.

Sue was taught to clap her hands together to receive her preferred game (Connect Four). The experimenter removed the game at the beginning of the session. If Sue emitted SIB or clapped her hands, she was given access to the game for 30 s. If neither response occurred within 5 s, the experimenter physically prompted Sue to clap her hands and then delivered the game. The prompt was delayed an additional 1 s contingent upon 5 consecutive trials without SIB.

John was taught to raise his hand as a means of terminating instructional trials. After presenting an instruction (e.g. "John, stand up"), the experimenter delivered praise contingent upon compliance and permitted John to escape the trial contingent upon occurrences of either SIB or hand raising. If no response occurred within 5 s following initiation of a trial, the experimenter raised John's hand and then terminated the trial. Completion of 5 consecutive trials without SIB resulted in the prompt being delayed an additional 1 s. The delay was increased to a maximum of 9 s. The original delay of 5 seconds allowed only the presentation of the verbal prompt. Delays of between 6 and 9 seconds allowed the presentation of both the verbal prompt and the touch prompt. Ten seconds after the delivery of the first prompt, the third prompt (physical guidance) occurred. Because the demand had been completed, at this point there was no opportunity for the therapist to guide the hand raise. Thus, continuation to a 10 second delay required the subject to either emit SIB or raise his hand in order to escape the demand. No consequences were provided for any SIB or hand raising occurring outside of the demand trial.

FCT with extinction. The consequences for signing were identical to those in the previous condition. In this condition, however, SIB no longer produced reinforcement. Thus, the only way to obtain reinforcement was by emitting the alternative response. Prompts were reinstated using the procedures described above. SIB exhibited by Rick and Sue was ignored (i.e., it did not produce access to the preferred item). John's SIB during instructional trials resulted in the experimenter's physically guiding John to complete the task.

CHAPTER 3
RESULTS

Functional Analysis

Figure 1 shows rates of SIB across assessment conditions for Rick. The highest rates of SIB were observed during the materials condition (M = 3.97 responses per minute), indicating that access to specific items served as positive reinforcement for his SIB. A small amount of SIB occurred during the play (0.03 responses per minute) and attention (0.2 responses per minute) conditions. No SIB occurred during the demand and alone conditions.

Similarly, the results of Sue's functional analysis (Figure 2) show SIB occurring almost exclusively in the materials condition. Although the mean rate of her SIB was 1.56 in the materials condition, it was only 0.01 across the other conditions. These results indicate that Sue's SIB was maintained by positive reinforcement in the form of access to a preferred item.

John's functional analysis was conducted using a pairwise design. Figure 3 shows that the highest rates of SIB occurred during the demand condition (M = 2.65 responses per minute). Although a small amount of SIB occurred in the play condition (M = 0.23 responses per minute), none occurred during the alone and attention conditions. These results indicate that John's SIB was maintained by negative reinforcement in the form of escape from demands.

Functional Communication Training

Figure 4 shows rates of SIB across conditions for all three subjects. Rick (top panel) exhibited a mean of 2.67 SIBs per min during baseline, which remained virtually unchanged when FCT was implemented without extinction (M = 2.54 responses per min).

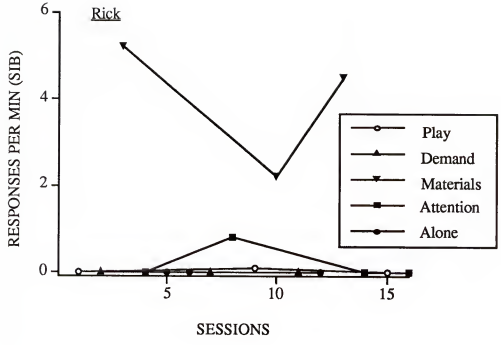

Figure 1. Responses per minute of SIB for Rick across assessment conditions.

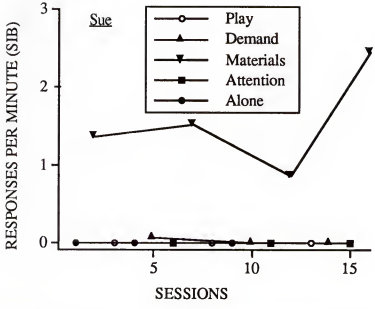

Figure 2. Responses per minute of SIB for Sue across assessment conditions.

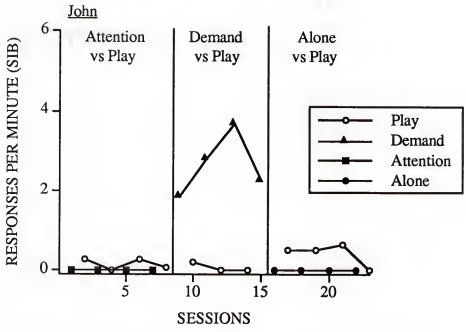

Figure 3. Responses per minute of SIB for John across assessment conditions.

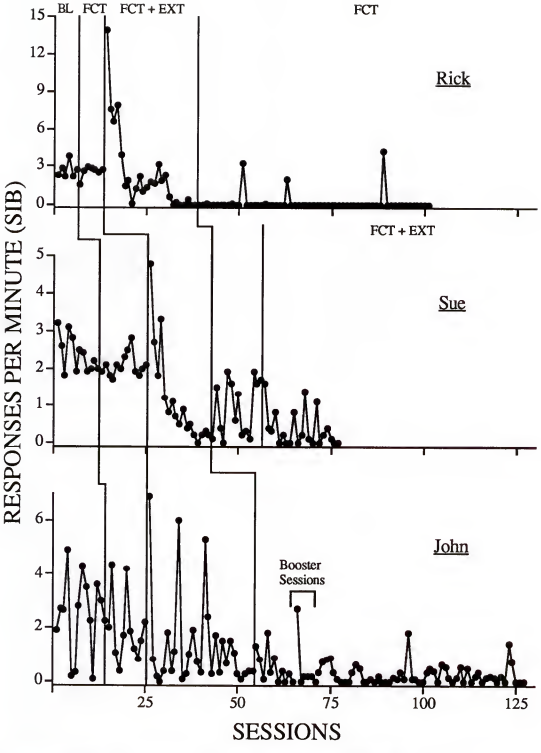

Figure 4. Responses per minute of SIB for each subject during baseline and across treatment conditions (FCT alone and FCT plus extinction).

During both of these conditions, independent signing remained unchanged (See Figure 5). In addition, due to Rick's high rate of SIB, few prompts were able to be delivered. When extinction was added to FCT, Rick's SIB increased initially (an apparent extinction burst), and then decreased rapidly. This decrease in SIB allowed the delivery of more sign prompts (M = 0.32 prompts per minute), thus resulting in an increase in independent signing. Subsequently (sessions 18-30), Rick exhibited both responses in what appeared to be a chained sequence. To the extent that SIB and signing occurred together, both were essentially extinguished, and this seemed to have happened by session 31. In an attempt to reestablish signing, the experimenter then began prompting Rick to sign on every trial if he did not do so independently (i.e., even if Rick emitted SIB). This modification resulted in an increase in Rick's signing and near elimination of his SIB. During the last 5 sessions of the FCT plus extinction condition, mean rates of SIB and signing were 0.08 and 1.28 responses per min, respectively. Extinction was then withdrawn to determine if signing would compete with SIB (when both were reinforced) once SIB had decreased and signing had increased. Rick showed no increase in SIB when extinction was removed (M = 0.11 responses per min), and, though no prompts were delivered, his signing remained stable (M = 1.48 responses per min).

Sue's SIB (middle panel) occurred at similar rates during baseline and FCT without extinction (M = 2.45 and 2. 25 responses per min, respectively). Unlike Rick, who never signed during baseline, Sue showed a low rate of clapping during baseline (M = 0.18 responses per min). Although some prompted clapping occurred (M = 0.47 responses per min), her independent clapping did not increase when FCT was implemented without extinction (M = 0.12 responses per min). When extinction was implemented in conjunction with FCT, Sue's SIB initially increased and then decreased to a mean of 0.19 responses per min during the last 5 sessions of the condition. A noticeable inverse

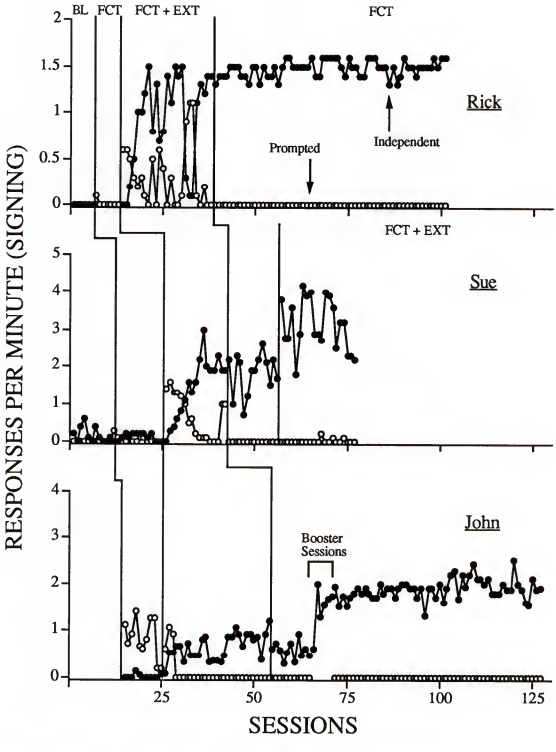

Figure 5. Responses per minute of prompted and independent signing for each subject during baseline and across treatment conditions (FCT alone and FCT plus extinction)

relationship was observed between SIB and clapping during this condition: As SIB decreased, clapping increased markedly (M = 1.98 responses per min for the last 5 sessions). Prompted claps gradually decreased throughout the condition. When extinction was withdrawn and prompting ceased, although Sue's hand clapping maintained, her SIB also increased. Because FCT without extinction was unsuccessful as a maintenance intervention for Sue, extinction was reimplemented. During this final condition, Sue's SIB decreased once again and her signing increased to a rate higher than that observed during any previous condition.

John (bottom panel) exhibited a variable rate of SIB during baseline (M = 2.4 responses per min), which decreased only slightly during FCT without extinction (M = 1.95 responses per min). Data were not collected on John's signing (arm raising) during baseline, although it occurred rarely, and it was observed only four times in 11 sessions during the FCT without extinction condition. Unlike Rick, prompts were able to be delivered (M = 0.84 responses per min) during this condition in spite of John's high rates of self-injury. When extinction was added to FCT, John's rate of SIB "spiked" periodically but decreased throughout the condition, while his rate of independent signing increased. As can be seen in Figure 5, prompts were only necessary during the first three sessions of the condition when extinction was a component of the treatment. As was the case with Rick, John emitted both responses during a number of trials throughout sessions 30-49; however, no special modifications were made in his treatment, and signing eventually occurred at rates higher than SIB. A slight increase in SIB was observed when extinction was removed; however, SIB remained below its baseline level, and signing maintained. Following session 65, John's treatment was interrupted for reasons unrelated to the study; therefore, treatment was resumed under the FCT plus extinction condition when he returned (noted as "booster sessions on the graph). Extinction was then removed

again, and during 55 maintenance probes conducted over a 2-month period, John's SIB remained low (M = 0.43 responses per minute). In addition, John's rate of independent signing maintained at a stable rate (M = 1.9 responses per minute) which could be described as almost perfectly efficient, as demands are delivered at a rate of 2.0 per minute.

At the completion of the study, all subjects engaged in low rates of SIB and high rates of independent signing, although Rick's and John's SIB continued to be reinforced. Prior to discharge, however, staff members at the institution were instructed in the implementation of both FCT and extinction as a precautionary measure.

CHAPTER 4
DISCUSSION

The primary purpose of this study was to evaluate the effectiveness of FCT in reducing SIB and teaching an alternative response (a manual sign) while SIB was concurrently reinforced. Although continued reinforcement for inappropriate behavior during treatment may seem unusual, it could occur in clinical practice either inadvertently or if therapists assume that consequences for such behavior are unimportant when implementing FCT. Results showed no decrease in SIB for any of the subjects when FCT was initially implemented without extinction. Likewise, no subject acquired the response that was intended to serve as a replacement for SIB. When SIB was placed on extinction, however, all three subjects showed marked decreases in SIB and began to exhibit the replacement sign independently. Thus, for all three subjects in this study, extinction was a necessary prerequisite for both the reduction of SIB and the acquisition of an alternative response.

A second purpose of this study was to determine if, once rates of SIB were reduced to acceptable levels and the alternative response was learned, the alternative response would compete with SIB if SIB were reexposed to reinforcement (which could occur for a variety of reasons in the natural environment). Results for all three subjects showed the maintenance of signing following the removal of extinction for SIB (i.e., when either SIB or signing produced reinforcement). Data on SIB revealed less consistent results. Rick engaged in very little SIB; instead, he showed almost exclusive preference for signing. John showed an initial increase in SIB, which subsequently decreased. Sue's data indicated that, in spite of the fact that she continued signing, she also began to exhibit more SIB. When both responses were reinforced, she switched from one response to the other throughout many sessions. As a result, extinction was reimplemented, after which her rate

of SIB again decreased. Thus, reexposure to reinforcement for SIB did not seriously disrupt signing or lead to an increase in SIB for two of the three subjects; for the third subject, intervention effects were compromised severely. In spite of the inconsistency in these results, they are somewhat more promising than those presented by Fisher et al. (1993) and Wacker et al. (1990), who found uniformly poor maintenance when extinction and/or punishment were removed following their combined use with FCT as initial interventions.

Several other features of the present results related to both acquisition and maintenance provide an interesting comparison with data from previous studies. Most of the research on FCT has not included data during initial acquisition of the alternative response, but it has been suggested that the behavior can be taught in a single training session (Carr & Durand, 1985a) or in as few as 6-18 min (Durand & Carr, 1992). By contrast, Horner and Day (1991) reported that it took 6, 9, and 21 sessions to teach alternative responses to their three subjects, and data presented by Wacker et al. (1990) during acquisition showed that, although one subject learned the alternative response immediately, the other two subjects required 3 and 9 training sessions before unprompted responses exceeded prompted ones. In the present study, Sue's rate of independent signing increased quickly during FCT plus extinction and was inversely related to her rate of SIB (signing occurred more often than SIB following 6 training sessions). Acquisition for Rick and John was more protracted. These individuals began to exhibit SIB and signing in combination, which resulted in apparent extinction of both responses for Rick. Although treatment was eventually effective, Rick and John required 21 and 28 training sessions, respectively, before their rates of signing exceeded their rates of SIB. Thus, results reported by several investigators (Horner & Day, 1993; Wacker et al., 1990) indicate that response acquisition during FCT may require extensive training for individuals who do not have highly developed verbal

repertoires, and our experience with two subjects (Rick and John) revealed that other problems such as response chaining may develop. These findings suggest that an alternative approach to treatment, which might produce more rapid acquisition of the alternative response in individuals who have severe learning disabilities, might consist of first decreasing the frequency of inappropriate behavior through extinction (or punishment) before attempting to teach the alternative response.

With respect to response maintenance, Horner and Day (1991) reported that, under conditions of concurrent reinforcement for both inappropriate and alternative behavior, the alternative behavior occurred more often if it was more "efficient" (i.e., "less effortful" or reinforced more often) than the inappropriate behavior. In the present study, both Rick's and John's rates of signing exceeded their rates of SIB when SIB was reexposed to reinforcement, even though both responses seemed to be of equal effort (head hit/body slap vs. hand clasp for Rick, head bang/hand bite vs. arm raise for John) and both were reinforced continuously. Thus, even when SIB and signing appeared to be of equal "efficiency," both subjects preferred the latter. Perhaps this was due to the fact that, although SIB produced reinforcement as readily as did signing, SIB also produced some undesirable consequences as well (i.e., painful stimulation). Sue, however, frequently switched between responses when both were reinforced during maintenance. Perhaps her SIB might have occurred at lower rates if it was reinforced less often or if reinforcement for SIB was reintroduced gradually. Both of these possibilities might occur in the natural environment if therapists occasionally reinforced SIB inadvertently or if their implementation of treatment procedures gradually deteriorated.

Considerations

In spite of the apparent ineffectiveness of functional communication training alone as a treatment for SIB, the use of FCT in conjunction with extinction might be recommended for several reasons. First, FCT, by definition, is designed to teach a communication

response. Most recipients of FCT are selected due to their lack of such skills. Adding appropriate functional responses to the communication repertoires of such individuals is advantageous in its own right. A second, related reason for combining FCT with extinction involves the control an individual possesses over his or her environment. Each new communicative response that is recognized and reinforced by the individual's verbal community adds to such control. Proponents of FCT (e.g. Carr & Durand, 1985a; Wacker et al., 1990) have suggested that control over the delivery of reinforcement may be an essential factor in the effectiveness of the treatment approach. Although research has suggested that this claim is not accurate, one could hardly argue with the general benefits of improving communication skills.

Other reasons for the use of a treatment package consisting of both FCT and extinction relate more to the effectiveness of such a package. For example, the use of FCT and extinction may result in a more efficacious reduction of SIB than the use of either procedure alone. Similarly, the use of FCT may attenuate extinction bursts sometimes seen in treatments based solely on extinction. Finally, the data presented in this study suggest that the extinction component may not be necessary once the new communicative response has been acquired and SIB reduced to acceptable levels. This is potentially important given the often inconsistent application of treatment procedures by those in contact with the individual. With FCT in place, reinforcement of an occasional self-injurious response may not result in deterioration of the treatment effect and the return of high rates of aberrant behavior.

There are, however, certain concerns regarding the use of FCT in conjunction with extinction. First, it remains unclear whether FCT hastens or hinders the treatment effects that result from the use of extinction. It is possible that procedures used in teaching the communicative response might actually reduce the effectiveness of extinction as a treatment. In the case of Rick, for example, reinforcement of hand clasps occurring in

close proximity to SIB resulted in the establishment of a SIB/sign chain. As a result, responding remained higher than might be expected had extinction been used alone.

Another consideration in using FCT, with or without extinction, is the continuous availability of reinforcers. It is often not feasible, for practical, educational, or health reasons, for reinforcers to be accessible to the individual at all times. For example, allowing Sue continuous access to her Connect 4 game would surely compete with ongoing activities such as self-care and other training activities. Likewise, allowing John to escape all demands would be deleterious to his training progress. Finally, most would consider it both socially unacceptable and unhealthy to allow Rick to wear the same shirt at all times. Therefore, it is important to consider the possibility that the individual's communication may not be acted upon be evaluated before deciding to use FCT (Doss & Reichle, 1991). This is not a problem inherent in FCT; however, implications for the use of intermittent schedules of reinforcement for the communicative response require a great deal of further exploration.

Directions for Future Research

Much research remains to be conducted before definitive answers regarding the use of FCT can be obtained. As stated above, it has yet to be determined whether FCT enhances or hinders the effectiveness of extinction as a treatment procedure. Studies are needed to compare extinction with and without functional communication training in terms of time to treatment criterion, number of inappropriate responses during treatment, side effects, and ease of implementation.

Similarly, many parameters of FCT need to be investigated and manipulated in order to improve the efficacy of FCT as an intervention. Methods for increasing the speed with which the communication response is acquired should be investigated. Horner and Day (1991), for example, found that responses on a richer schedule of reinforcement were acquired faster than those on leaner schedules of reinforcement. The results of the current

study demonstrated success when SIB was on extinction and signing was continuously reinforced, representing the largest possible discrepancy in efficiency. Perhaps reinforcing SIB on an intermittent schedule, rather than continuously, while reinforcing the communication response on a CRF schedule would be sufficient to reduce SIB and teach the new response, thus not requiring extinction.

Conclusion

The present results suggest that FCT is not effective in reducing SIB or in establishing a replacement response if SIB continues to be reinforced during training. However, once the alternative response has been acquired, continued reinforcement of the behavior might produce enduring treatment effects in spite of occasional inadvertent reinforcement for inappropriate behavior. Despite these results, FCT should not be discarded as an intervention for the treatment of self-injurious behavior. The results do suggest, however, that the intervention should be used in conjunction with other well-established and effective treatment procedures, such as extinction. When used in this manner, FCT can result in increasing the communicative repertoire of individual's with mental retardation. Much work remains to be done, however, to determine the most effective and appropriate method of using functional communication training as a decelerative strategy in treating self-injurious individuals.

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BIOGRAPHICAL SKETCH

Melissa Jeanne Shirley was born on February 14, 1969, in Great Barrington, Massachusetts. After completing high school in Cocoa, Florida, she was admitted to the University of Florida. In 1990, she received a Bachelor of Science degree in psychology and applied to the graduate program in the experimental analysis of behavior. She was accepted to the program and began studying under the guidance of Dr. Pennypacker. in the Fall of 1990.

Throughout her graduate career, she has conducted research in the areas of precision teaching and fluency under the supervision of Dr. Pennypacker. Additionally, she has been a research assistant at the Center for Self-Injury under the direction of Dr. Iwata. She plans to continue applying her knowledge of applied behavior analysis in the field of developmental disabilities.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Henry S. Pennypacker, Chair
Professor of Psychology

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Brian A. Iwata, Cochair
Professor of Psychology

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Timothy D. Hackenberg
Associate Professor of Psychology

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Ira S. Fischler
Professor of Psychology

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Mary K. Dykes
Professor of Special Education

This dissertation was submitted to the Graduate Faculty of the Department of Psychology in the College of Liberal Arts and Sciences and to the Graduate School and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

August, 1996

Dean, Graduate School